kcc 10/1/2020

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MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See http://www.mtsu.edu/sga/cleanenergy.shtml for funding guidelines. Save completed form and email to cee@mtsu.edu or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request Beng Guat Ooi	
Department/Office SCI 3081	Phone # (Office) 615-898-2076
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E-mail bgooi@mtsu.edu	Submittal Date 10/1/2020

2. Project Categories (Select One)			
Select the category that best describes the project.			
	Energy Conservation/Efficiency		Sustainable Design
X	Alternative Fuels	X	Other (Research)
	Renewable Energy		

3. Project Information
a. Please provide a brief descriptive title for the project. **b.** The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. **Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.** c. List the source of project cost estimates. d. Provide a brief explanation in response to question regarding previous funding.
3a. Project Title Development of High Performance Additives for Alternative Fuels to Reduce the Emissions of Pollutants
3b. Project Cost Estimate $4,474.00 ($4200 for the processor and $274 for the lab stand)
3c. Source of Estimate Online prices of Vial Tweeter stand and Hielscher process from Sigma Aldrich vendor are given at the end of the project description.

4. Project Description

(Completed in as much detail as possible.)

a. The scope of the work to be accomplished is a detailed description of project activities.
b. The benefit statement describes the advantages of the project as relates to the selected project category.
c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
e. Provide specific information on anticipated student involvement or benefit.
f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

4a. Scope: Work to be accomplished

An ultrasonic processor and a sample processor stand are used to expedite the reaction of chemical precursors to form products with high yields in short time periods. Emphasis will be placed on the use of glycerol by-product from biodiesel production and the biomass-derived intermediate chemical called 5-hydroxymethylfurfural. Our research goal is to produce fuel additives with high oxygen content to improve the emission profile by reducing the release of carbon monoxide, nitrogen oxides, particulate matter, and volatile organic compounds. The fuel additives composed of alcohols, esters and ethers will be analyzed by infrared and Raman spectrometry before blended into gasoline and diesel fuels. These fuel formulations will be tested for combustion in power generators and their emissions will be collected into Tedlar bags for analysis by gas chromatography-mass spectrometry. The ultimate goal is to produce biofuel additives that are environmentally sustainable when used as transportation fuels.

4b. Scope: Benefit Statement

The development of green and sustainable production methods for fuel additives can reduce the reliance on the non-renewable petroleum-based fuels. The clean-burning additives will produce less carbon dioxide that is considered the culprit for global warming. The use of glycerol and 5-hydroxymethyfurfural from seed oils and cellulosic carbohydrates, respectively, would decrease the carbon footprint. The oxygen-containing additives have been shown to reduce the toxic emission of carbon monoxide and carcinogenic volatile organic compounds like benzene, formaldehyde, and 1,3-butadiene.

4. Project Description (continued)

4c. Location of Project (Building, etc.)

Science Building-Room 3080/3093/3101

4d. Participants and Roles

Beng Guat Ooi: Purchase and installation of the ultrasonic processor; using ultrasonic device in teaching and research; evaluating the efficiency of the device in improving product yields and shorten reaction times to achieve savings in energy.

Research students: Learn to use the ultrasonic generator for chemical reactions and explore its other uses for preparing colloidal nanoparticles and lysing bacterial or yeast cells for studying biomarkers of metabolic processes.

4e. Student participation and/or student benefit

Students using the ultrasonic generator will be able to complete their chemical synthesis in less than half the time compared to the more common "heat and stir" approach. It also results in a higher product yield and helps make a reaction more economically feasible. Students will also learn different chromatographic and spectroscopic techniques besides the sonication methodologies for multiple research projects in the laboratory.

4f. Future Operating and/or Maintenance Requirements

The ultrasonicator device does not require much maintenance. Our Instrument Support Engineer, can help with troubleshooting or repair if necessary. The Biochemistry laboratory has other equipment for performing the biofuels research.

4g. Additional Comments or Information Pertinent to the Proposed Project

The Hielscher ultrasonic generator is capable of the following research applications including (i) Ultrasonic Homogenizing (ii) Ultrasonic Dispersing and Deagglomeration (iii) Ultrasonic Cell Disintegration (iv) Ultrasonic Transesterification of Oil to Biodiesel, and (v) Ultrasonic Degassing of Liquids.

5. Project Performance Information

Provide information if applicable.

a. Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
b. Provide information on estimated annual energy cost savings in monetary terms.
c. Provide information on any annual operating or other cost savings in monetary terms. Be specific.
d. Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

Not applicable because that there are currently no sonochemical devices at MTSU to compare the Hielscher ultrasonic generators with.

5b. Annual Energy COST Savings ($)

Not applicable.

5c. Annual Operating or Other Cost Savings. Specify. ($)

Other research-related expenses for sonochemical synthesis are estimated at about $300 per year.

5d.Matching or Supplementary Funding (Identify and Explain)

The Department of Chemistry will pay for the annual operating course of about $300 per year. I already have other equipment items for my biofuel research project and so no other expenses are anticipated besides the annual operating cost and the cost of purchasing the ultrasonic device.

Hielscher processors and VialTweeter

Sonication is a very effective method for the mixing, homogenizing, emulsifying, dispersing, disintegration, and degassing of liquids by means of ultrasonic cavitation. The VialTweeter applies this technology to vials, such as autosampler vials, storage vials and reagent vials without the need to open the cap or any water bath.

The VialTweeter is an effective alternative to the sonication of vials in ultrasonic cleaning baths or tanks, in which the water surrounding the vials takes most of the energy - while the effective power in a 1.5 mL vial is as low as 0.01 watt. For sonication processes, this is no power at all.

The VialTweeter delivers up to 10 watts to each of the six vials in its high intensity part and up to 5 watts to the two vials placed in its low intensity part. These power levels allow for sophisticated sonication processes (see a list at the end of this page), in short time, similar to direct sonication by a homogenizer.

The VialTweeter can sonicate a test tube, bottle or beaker of up to 500 mL volume attached to its end, too. The power can be adjusted by means of the amplitude adjustment at the front panel of the generator. Once set, the amplitude will be maintained at the adjusted value and will is distributed evenly across the 6 high intensity vials and the 2 low intensity vials, respectively. This gives you reproducible sonication effects.

The VialTweeter is powered by the Hielsher ultrasonic processor. As the ultrasonic generator is tuned to the frequency of the sonotrode automatically, there is no manual frequency tuning required. For a good transmission of the ultrasonic vibrations to the individual vials, the vials are pushed gently into the holes of the VialTweeter. Each hole of the VialTweeter is made to hold vials of the most common sizes, brands and designs. At the end of the VialTweeter, a single vessel can be attached for sonication.

For the direct sonication of liquids the Hielsher ultrasonic processor can be equipped with sonotrodes for immersion into liquids. In that way, it can be used as a hand-held or stand-mounted homogenizer.

The exchange between the VialTweeter and the sonotrodes takes approx. 5min.

Product #	Description	Add to Cart
Z878888	Hielscher Lab stand for ultrasonic processor stainless steel, diam. 18 mm, L × W × H 300 mm × 150 mm × 300 mm	close

SKU-Pack Size	Availability	Pack Size	Price (USD)	Quantity
Z878888-1EA	Only 1 left in stock (more on the way) - FROM	1 ea	274.00	0

Bulk orders?

Please enter a valid quantity for

ADD TO CART

Z878929	Hielscher Lab ultrasonic processor AC/DC input 230 V AC, Schuko plug	close

SKU-Pack Size	Availability	Pack Size	Price (USD)	Quantity
Z878929-1EA	Estimated to ship on 11/16/26	1 ea	4,200.00	0

Bulk orders?

Please enter a valid quantity for

ADD TO CART